COSEWIC
Assessment and Update Status Report

on the

American marten
Martes americana atrata

Newfoundland population

in Canada

Newfoundland population - THREATENED
2007

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

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Previous reports:

COSEWIC 2000. COSEWIC assessment and update status report the Newfoundland marten *Martes americana atrata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 9 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

Lemon, J. 1996. Update COSEWIC status report on the Newfoundland marten *Martes americana atrata* in Canada (Newfoundland population). Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-9 pp.

Skinner, W. R. 1979. COSEWIC status report on the Newfoundland pine marten *Martes americana atrata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 14 pp.

Snyder, J. E. 1985. Update COSEWIC status report on the Newfoundland marten *Martes americana atrata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 42 pp.

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In 2007, the common name Newfoundland Marten *Martes americana atrata*, was changed to American marten (Newfoundland population) *Martes americana atrata*. Please note that the species is still referred to as Newfoundland marten in this update report.

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COSEWIC
Assessment Summary

Assessment Summary – April 2007

Common name
American marten - Newfoundland population

Scientific name
Martes americana atrata

Status
Threatened

Reason for designation
Marten in Newfoundland have declined substantially over the last century. The current population consists of 300-600 mature marten in 5 subpopulations. It is still at risk because of snaring and trapping outside of protected areas and because of forest harvesting. A small decrease in population size would likely result in consideration for Endangered status. The marten is one of few land mammals native to Newfoundland and the sub-species is endemic to Canada.

Occurrence
Newfoundland

Status history
Designated Not at Risk in April 1979. Status re-examined and designated Threatened in April 1986. Status re-examined and designated Endangered in April 1996 and in May 2000. Status re-examined and designated Threatened in April 2007. Last assessment based on an update status report.

COSEWIC
Executive Summary

American marten
Martes americana atrata

Newfoundland population

Species information

The subspecies of American marten, *Martes americana atrata*, is native to the island of Newfoundland and the Labrador peninsula. The subspecies of American marten have not been reviewed vis-à-vis recent studies showing genetic uniqueness from mainland populations. The Newfoundland population of American marten is designatable on the basis of genetic and ecological distinctiveness.

Distribution

The historical range of American marten in Newfoundland is assumed to have been contiguous within forested areas. The range contracted in the 20th century and currently includes pockets of forested habitat in western Newfoundland (Little Grand Lake/Red Indian Lake and Main River) and on the east coast (Terra Nova area). Smaller populations occur in peripheral areas near St. Georges and Lobster House.

Habitat

Marten are typically associated with mature and overmature conifer and mixed-wood forests throughout their range in North America. However, a recent study suggests that marten inhabit a wider array of habitats, including mid-successional and young regenerating softwoods in addition to old growth forests, in Newfoundland. Mainland marten require dense overhead cover, coarse woody debris, low-hanging branches and shrub understory. These requirements are relaxed in Newfoundland where the landscape is highly fragmented. Of the total area occupied by marten, 10% is protected from forest harvesting, while 16% of critical habitat is protected. Critical habitat encompasses 51% of the area of occupancy.

Biology

The marten is an opportunistic feeder; however, the meadow vole is the most important food item throughout the year. The meadow vole is normally associated with open habitat, but occupies overmature or oldgrowth coniferous forests in Newfoundland. Snowshoe hares are important prey, especially in winter, and prefer early to mid-

successional forests. The use of southern red-backed voles, first documented in 1999, is expected to increase as the voles expand their range.

Population sizes and trends

The Newfoundland marten's range and population size has contracted throughout the 20th century, principally as a result of habitat change, overtrapping and accidental mortality. In 1985, there were an estimated 630 to 875 marten, based on live-trapping studies, distribution determined from a trapper questionnaire, and locations of sightings and accidental mortalities. In 1995, the estimate was less than 300 marten, based on known densities, habitat supply and known distribution. The current estimate, based on the 1990-2006 distribution, empirical densities from live-trapping studies, and habitat supply analysis is 438 to 852, including up to 25% juveniles. While the distribution has expanded since 1985, from 13,356 km^2 to 23,383 km^2, the population appears to be stable. The population estimates are not derived from comparable methods.

Limiting factors and threats

The major limiting factors are accidental trapping and snaring and habitat loss due to forestry. Secondary factors are habitat loss due to fire and insect damage and the limited prey base. Accidental trapping and snaring is a major threat to marten recolonizing habitats outside protected areas.

Special significance of the population

The American marten is one of only 14 mammals native to Newfoundland. The genetic and ecological uniqueness of the population makes it a component of biodiversity in Canada.

Existing protection

The American marten population of Newfoundland is protected under the *federal Species at Risk Act*. The population was designated Endangered in May, 2000 and is listed on Schedule 1.

The *provincial Endangered Species Act* also lists the marten as endangered and has a series of general prohibitions similar to the federal legislation. Some habitat is protected in reserves and parks. Critical habitat has also been identified as part of the recovery planning process, and 16% is fully protected from wood harvesting, snaring and trapping. Commercial trapping has been illegal since 1934. The Newfoundland government created a Pine Marten Study Area in 1973, where all land trapping and snaring was forbidden. Marten are also protected in two National Parks and 3 reserves in the Little Grand Lake area. Modified snares are required in the Northwest Grand Lake, Red Indian Lake, Terra Nova and Charlottetown Enclave areas and the live-release of all accidentally captured marten is encouraged. A total of 57% of all marten critical habitat areas are protected against accidental mortality through closures to snaring and trapping, or modified snare requirements.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

Update
COSEWIC Status Report

on the

American marten
Martes americana atrata

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INTRODUCTION

The American marten, Newfoundland population, was first assessed by COSEWIC as Not At Risk (formerly Not In Any Category, Skinner 1979). An updated status report (Snyder 1985) resulted in re-assessment of Threatened in 1986 based on the harvest rate of its limited forest habitat. Data deficiencies included information on local marten biology, ecology and responses to forest management practices.

A Newfoundland Marten Recovery Team was formed in 1990. The National Recovery Plan for the Newfoundland Marten was completed in 1995 (Forsey *et al.* 1995) and an updated status report prepared in 1996 (Lemon 1996). This resulted in re-assessment to Endangered based on population declines and continuing threats to habitat (essentially old growth conifer stands). Revised population and habitat loss estimates were based primarily on the National Recovery Plan (Forsey *et al.* 1995). The status was confirmed by COSEWIC in 2000 using new quantitative criteria applied to information in the existing 1996 status report (COSEWIC 2000).

This third updated status report, summarizes new information that has become available since 1996. It is not a complete review of all information on the American marten, Newfoundland population. The first update status report (Snyder 1985) and the Newfoundland Marten Recovery Plan (Forsey *et al.* 1995) provide additional information. An updated recovery strategy and action plan are in preparation (The Newfoundland Marten Recovery Team, in preparation, a and b).

SPECIES INFORMATION

Name and classification

The recognition of subspecies of American marten, *Martes americana*, based on morphological data remains tentative and controversial. Hall (1981) distinguished 14 subspecies; including *M. americana atrata*, a subspecies endemic to Newfoundland. Other authors argued that the partitioning of subspecies was arbitrary and subject to error based on small sample sizes or samples biased by sex or coat colour variation (Hagmeier 1958, 1961; Anderson 1970; Clark *et al.* 1987). Hagmeier (1958, 1961) and Clark *et al.* (1987) recognize *M. americana atrata* as the Newfoundland subspecies, but include *M. americana brumalis*, found in northen Quebec and Labrador, as a synonym. The subspecies of American marten have not been reviewed vis-à-vis recent studies showing genetic uniqueness from mainland populations.

Morphological description

The American marten is a long, slender arboreal weasel with short limbs, broad feet and semi-retractable claws used for climbing. The head is broad, tapering to a sharp nose and the ears are large and rounded. Its bushy tail is about ½ of the body length. The long, silky, dense fur varies from pale buff, to dark brown dorsally. A bib on

the throat and chest may be creamy to bright orange. Males are about 15% longer than females and up to 65% heavier.

Martes americana atrata, found in Newfoundland, Labrador and northern Quebec (Figure 1) is a large, dark race (Hagmeier 1961) compared with the small pale form to the south and west (*M. americana americana*). The subspecies, and the population in Newfoundland, are comparatively large, with mean weights for males of up to 1,325 g. (Bissonette *et al.* 1988, Smith and Schaefer 2002, Hearn *et al.* 2005).

Figure 1. Newfoundland marten, *Martes americana atrata*. Photographer: Lem Mayo.

Genetic description

Carr and Hicks (1997) showed no divergence of the Newfoundland marten from most mainland populations of the *americana* group based on the cytochrome b gene of mtDNA. However, in microsatellite DNA (Kyle and Strobeck 2003), and to some extent in randomly amplified polymorphic DNA (McGowan *et al.* 1999), the Newfoundland population is genetically distinct from mainland marten populations of the *americana* group, which shows relative homogeneity, suggesting genetic connectivity, across Canada (Kyle and Strobeck 2003). The genetic variation of Newfoundland marten is significantly lower than that of mainland populations (McGowan *et al.* 1999, Kyle and Strobeck 2003). The average expected heterozygosity (H_E) of the Newfoundland population was 40.2% vs. 63.6% averaged for 24 mainland populations from across Canada (Kyle and Strobeck 2003).

Low genetic diversity and divergence from mainland populations are consistent with genetic drift and the absence of immigration as a result of isolation since the last

ice age. Recent population declines may further decrease genetic variation on the island. The population introduced in the Main River watershed from other parts of Newfoundland shows lower genetic diversity than other populations on the island (M. McGrath, pers. comm., 2007) as a possible founder effect and indicator of isolation. The Newfoundland population of American marten is designatable on the basis of genetic and ecological distinctiveness (Green 2005).

DISTRIBUTION

Global and Canadian range

The American marten is distributed throughout the coniferous forests of the boreal and taiga zones of North America (Gibilisco 1994). While habitat loss and fragmentation due largely to logging have resulted in population declines and extirpations in many regions (Bissonette *et al.* 1989, Thompson 1991), conservation efforts and forest succession have allowed some populations to re-establish (Gibilisco 1994). The Canadian range of *M. americana atrata* includes Newfoundland, northern Quebec and Labrador. The genetically distinct Newfoundland population occurs only on the island of Newfoundland.

Newfoundland range

The historical range of American marten in Newfoundland is assumed to have been contiguous within forested areas (Bergerud 1969). The range contracted in the 20th century, in all likelihood as a result of overtrapping and the removal of forest habitat by logging and fires. Sequential marten publications and status reports by Bergerud (1969), Skinner (1979), Snyder (1985), Lemon (1996) and COSEWIC (2000) documented a trend in range reduction. The current extent of occurrence is 68,700 km^2 (A. Filion, pers. comm., 2006), and includes a large unoccupied area between the eastern and western populations (Figures 2 and 3).

The current range includes 23,383 km^2 of pockets of forested habitats in western (Figure 2) and eastern Newfoundland (Figure 3). Four core areas occupied by adult resident marten are recognized in the Terra Nova, Main River and Little Grand Lake-Red Indian Lake and St. George's areas (2,829 km^2, 2,177 km^2, and 6,232 km^2, 590 km^2, respectively, totalling 11,828 km^2) (I. Schmelzer, pers. comm., 2007). Isolated adult residents and juveniles or unconfirmed residents occupy an additional 11,555 km^2 of peripheral areas (I. Schmelzer, pers. comm., 2007). This area includes a potential 5th core area of 260 km^2 in the Lobster House area.

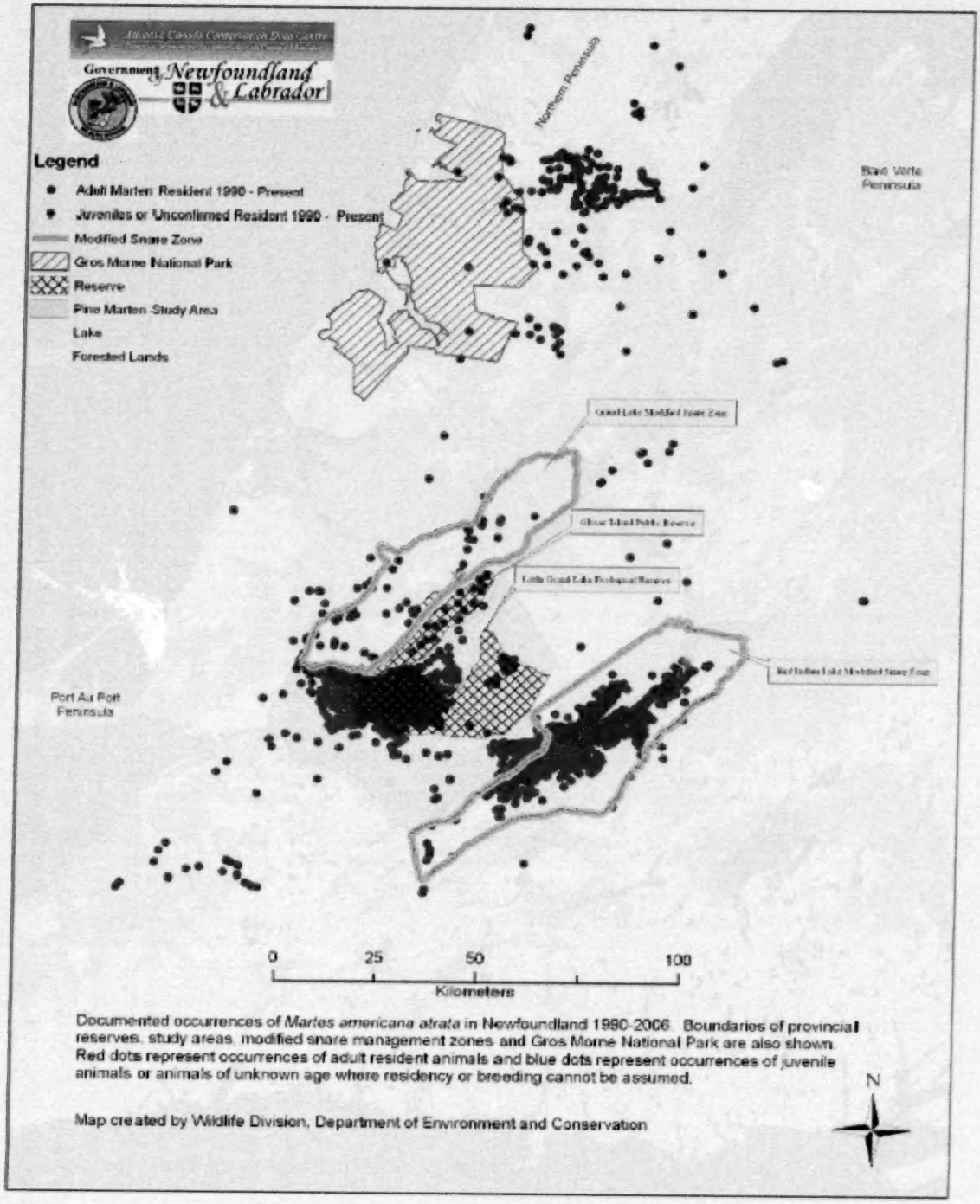
Government of Newfoundland & Labrador
Legend
Adult Marten Resident 1990 - Present
Juveniles or Unconfirmed Resident 1990 - Present
Modified Snare Zone
Gros Morne National Park
Reserve
Pine Marten Study Area
Lake
Forested Lands
Northern Peninsula
Baie Verte Peninsula
Port Au Port Peninsula
0
25
50
100
Kilometers
N
Documented occurrences of Martes americana atrata in Newfoundland 1980-2006. Boundaries of provincial reserves, study areas, modified snare management zones and Gros Morne National Park are also shown. Red dots represent occurrences of adult resident animals and blue dots represent occurrences of juvenile animals or animals of unknown age where residency or breeding cannot be assumed.
Map created by Wildlife Division, Department of Environment and Conservation

Figure 2. Recent distribution of the American marten in western Newfoundland. Map created by Wildlife Division, Newfoundland & Labrador Department of Environment and Conservation.

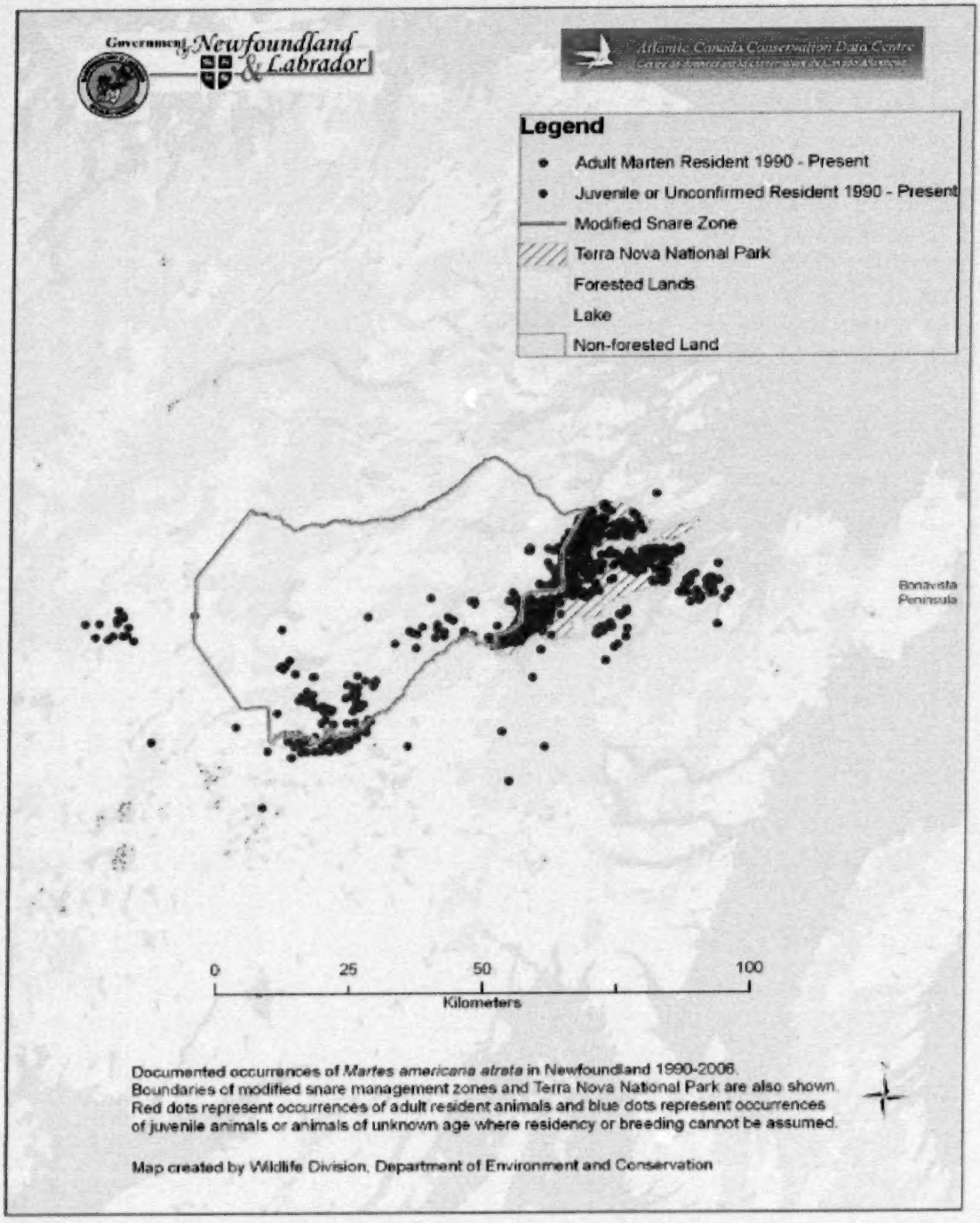
Government of Newfoundland & Labrador
Atlantic Canada Conservation Data Centre
Legend
Adult Marten Resident 1990 - Present
Juvenile or Unconfirmed Resident 1990 - Present
Modified Snare Zone
Terra Nova National Park
Forested Lands
Lake
Non-forested Land
Bonavista Peninsula
0
25
50
100
Kilometers
Documented occurrences of Martes americana atrata in Newfoundland 1990-2006.
Boundaries of modified snare management zones and Terra Nova National Park are also shown.
Red dots represent occurrences of adult resident animals and blue dots represent occurrences
of juvenile animals or animals of unknown age where residency or breeding cannot be assumed.
Map created by Wildlife Division, Department of Environment and Conservation

Figure 3. Recent distribution of the American marten in Eastern Newfoundland. Map created by Wildlife Division, Newfoundland & Labrador Department of Environment and Conservation.

The current area of occupancy (23,383 km^2, with 11,828 km^2 in core areas, Figure 4) is greater than that estimated in 1985 (13,356 km^2, with 4,551 km^2 in core areas) (Hancock *et al.* 1985). There have been gains in distribution as transplanted populations in the Main River and Terra Nova areas have increased. The data base for marten distribution, based on live-trapping, accidental captures, radio telemetry, bait stations, and incidental sightings has improved in recent years, giving more accurate delineations of core and peripheral areas (I. Schmelzer, pers. comm., 2007). The area of occupancy is believed to be 25% of the historical distribution, or about 60% of the distribution observed in the mid-20th century (The Newfoundland Marten Recovery Team, in preparation, a).

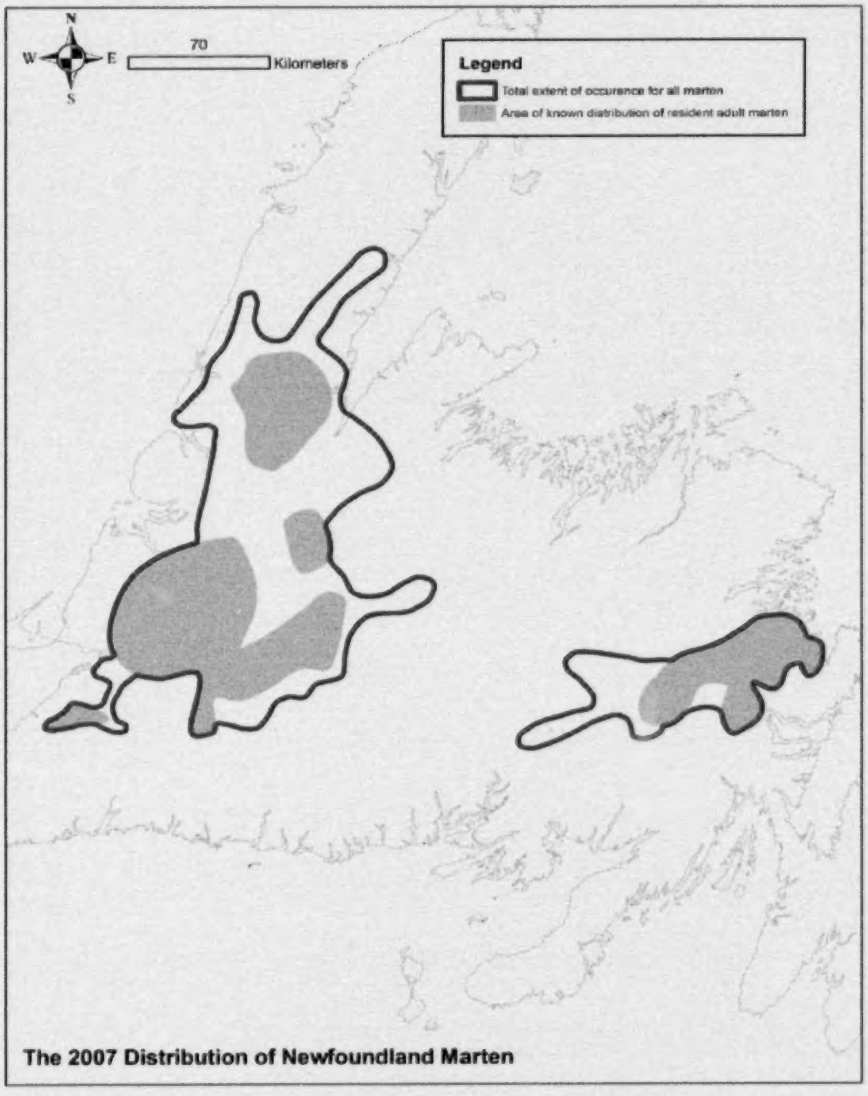

Figure 4. The known total distribution of American marten on the island of Newfoundland in 2007.

HABITAT

Habitat requirements

Historically, marten have been strongly associated with mature and overmature conifer and mixed-wood forests throughout their range in North America (Thompson and Curran 1995, Payer and Harrison 2003). Structural features of these forests important to marten include dense overhead cover, coarse woody debris, low-hanging branches and shrub understory. These features provide protection from predators, subnivean access for hunting, denning and resting sites (also important for thermoregulation), and habitat for prey species

Recent research has demonstrated that resident adult marten also use partially harvested stands, stands defoliated by insects, early successional forests regenerating after clearcutting (reviewed in Payer and Harrison 2000, 2003; also Potvin *et al.* 2000, Poole *et al.* 2004, Hearn *et al.* 2005) and burns and partial burns (Paragi *et al.* 1996), if important horizontal and vertical structural features are retained. Marten have evolved in Newfoundland to be habitat generalists, aided in part by a release from predation, which allows them to occupy a naturally fragmented landscape. Hearn *et al.* (2005) concluded that marten in southwest Newfoundland selected an array of habitats including mid-successional and young regenerating softwoods. Stands logged within 20 years and regenerating stands that had been pre-commercially thinned were also used in proportion t[illegible]eir availability in conjunction with mature and overmature forests.

Previous studies in Newfoundland documented a preference for old growth forests, specifically mature balsam fir (*Abies balsamea*) (Snyder and Bissonette 1987, Bissonette *et al.* 1989, Thompson and Curran 1995, Forsey and Baggs 2001). During this period marten were restricted to old growth because trapping and snaring prevented their colonization of other habitat types (Hearn *et al.* 2005; D. Harrison, pers. comm., 2007). Although snowshoe hares were most abundant in 40-year-old second growth stands (Thompson and Curran 1995), both marten and their primary prey species, meadow voles, occurred in low numbers. The abundance of meadow voles was negatively correlated with tree density and positively correlated with coarse woody debris. Voles were most abundant in overmature stands (Thompson and Curran 1995, Sturtevant 1996, Sturtevant and Bissonette 1997).

Marten habitat associations in Newfoundland were not studied when all historically occupied regions contained marten populations. Rather, research began after the populations had contracted to inaccessible areas of the island, where forest harvesting and trapping were limited or absent. By default these were mature and overmature forests. Hearn *et al.* (2005) hypothesized that immature forests can support marten due to the availability of snowshoe hare as prey, and the reduced need for cover from predators, which are less common in Newfoundland as compared to the mainland.

Fuller *et al.* (2006) modelled percent suitable habitat within marten home ranges, and found the probability of occupancy to be 90% when home range-sized habitat units

contained at least 60% suitable habitat. The probability of occupancy declined sharply when suitable habitat in the landscape was <60%. The rate of decline in occupancy was steepest between 30 – 40% of suitable habitat within the home range. The mean amount of suitable habitat within home ranges was 47%, and 80% of all marten had ≥38%, while only 6.5% of marten had ≤30% suitable habitat within their home range. Models including fragmentation variables did not perform any better, suggesting that habitat fragmentation is not as important a variable influencing home range occupancy as the amount of suitable habitat alone. Marten in Maine exhibited declines in home range occupancy much sooner as percent suitable habitat declined. Fuller *et al.* (2006) hypothesized that the Newfoundland population has evolved in a naturally fragmented landscape where a large body size and larger home ranges allow it to include more unsuitable habitat in home ranges. Suitable habitat included insect-killed stands, pre-commercially thinned stands, medium and tall closed canopy softwood stands, tall open-canopy softwood stands, and regenerating clearcuts (≤6.5m tall, ≥75% canopy closure) (Hearn *et al.* 1995).

Overall, there was equivocal evidence that martens prefer mature forest types. Tall open-canopy softwood had the highest positive selection index at both the landscape and stand scale. Tall-closed softwood and medium-open softwood had intermediate selection values and were used in proportion to their availability. Median availability of mature and overmature forests within the study area ranged between 20% to 40%. The median amount of mature and overmature forest within occupied home ranges was 30% (Hearn *et al.* 2005). However, marten did not select home ranges dominated by mature and overmature coniferous forests at the landscape scale. Unsuitable habitat types included bog, rock, soil barrens, unmerchantable softwood (≤6.5m tall) and medium height open-canopy softwood. The maximum cumulative amount of unsuitable habitat types within marten home ranges was 35% (Hearn *et al.* 2005).

Habitat trends

Given the new habitat model for Newfoundland marten (Hearn *et al.* 2005), past (at the times of previous status assessments) and current habitat trends are unclear. Past predictions of habitat shortages and extinction risks due to logging, natural forest mortality, and trapping/snaring are now debatable (Thompson 1991, Schneider and Yodzis 1994, Schneider 1997). Similarly, past forest management prescriptions are now ambiguous until reviewed against Newfoundland marten habitat requirements (e.g., Sturtevant *et al.* 1996, Sturtevant *et al.* 1997, Thompson and Curran 1995, Chapin *et al.* 1998, Hargis *et al.* 1999, Potvin *et al.* 2000, Payer and Harrison 2003).

Continued logging in Newfoundland is reducing the quantity of old growth habitat (Forsey *et al.* 1995). An estimated 73.5 km^2/year of mature and overmature forest was harvested annually between 1985 and 1993 (Lemon 1996). The current forest harvest rate is approximately 200 km^2/year (B. English, pers. comm., 2006). While the current average harvest age is 100 years, many natural second growth forests will be harvested in the future as early as 60 to 80 years of age (B. English, pers. comm., 2006).

Habitat protection/ownership

Most of the marten's range is on public or "Crown" lands. Approximately 14% of the current area of occupancy by American marten is within protected areas (27% of the Terra Nova core area, 6% of the Main River core area, and 20% of the Little Grand Lake-Red Indian Lake core area) (J. Brazil and I. Schmelzer, pers. comm., 2007). Additional protected areas include provincial parks and wilderness reserves. Ten percent of the area of occupancy is protected from wood harvesting alone, 21% is closed to all trapping and snaring, and an additional 18% is within modified trap and snare zones (I. Schmelzer, pers. comm., 2007).

Sixteen percent of all critical habitat is fully protected; 16% is protected from wood harvesting alone, 29% is closed to all trapping and snaring, and an additional 28% occurs in modified trap and snare zones (I. Schmelzer, pers. comm., 2007). Critical habitat encompasses approximately 51% of the area of occupancy.

Protected areas include Gros Morne (1,805 km^2) and Terra Nova (392 km^2) National Parks. Limited timber harvesting continues within one national park and in the sections of the Pine Marten Study Area which are not within reserves. The Little Grand Lake Provisional Ecological Reserve was established in 2002. Two other protected areas were established in 2002; the Little Grand Lake Wildlife Reserve (569 km^2) and the Glover Island Public Reserve (178 km^2). A total of 6,160 km^2 has been proposed as critical habitat for forest habitat management planning purposes, and there is no harvest in critical habitat (J. Brazil, pers. comm., 2007).

BIOLOGY

Life cycle and reproduction

Captive breeding of Newfoundland marten was attempted at Salmonier Nature Park, producing litters in 1999 and 2002 (Heath *et al.* 2001). Captive breeding is no longer being carried out.

Predation

The most significant predator of marten in Newfoundland is the red fox (*Vulpes vulpes*). Other potential mammalian predators and competitors include black bear (*Ursus americanus*), Canada lynx (*Lynx canadensis*) and coyote (*Canis latrans*). The coyote expanded its range to the island during the 1980s. The wolf (*Canis lupus*) was extirpated from Newfoundland in the early 20th century. The only potential avian predator is the great horned owl (*Bubo virginianus*).

Drew and Bissonette (1997) reported details of nocturnal behaviour of marten in winter, possibly hunting red squirrels resting in subnivean middens, or snowshoe hares. Alternatively, marten may have been reducing the risk of predation by predators such as

the red fox which might be less efficient at night. In colder climates, thermal constraints favour diurnal activity and the nocturnal use of subnivean resting sites. Hearn *et al.* (2005) suggested that predation risk is relatively low for Newfoundland marten compared to mainland populations, allowing them a broader niche in terms of more open habitats with less overhead cover.

Interspecific interactions

The prey base available to marten in Newfoundland is thought to be limited compared to that in other parts of the marten's North American range. Prior to 1864, the only major prey species was the meadow vole (*Microtus pennsylvanicus*). The significance of arctic hare (*Lepus arcticus*) as a historical marten food is unknown. Arctic hares once ranged across Newfoundland in relatively high densities (Dodds 1983). The introduction of the snowshoe hare indirectly led to an extensive range reduction of the arctic hare presumably through an increase in lynx numbers (Bergurud 1967). Caribou (*Rangifer tarandus*) carrion was also available.

Several significant prey species have been introduced. The snowshoe hare (*Lepus americanus*) was introduced in the 1860s and moose (*Alces alces*, available as carrion) in 1878. Recent introductions include the masked shrew (*Sorex cinereus*; 1958), red squirrel (*Tamiasciurus hudsonicus*; 1964), eastern chipmunk (*Tamias striatus*, 1962), deer mouse (*Peromyscus maniculatus*, 1968, Gould and Pruitt 1969), southern red-backed vole (*Clethrionomys gapperi*, 1999, Hearn *et al.* 2006, in press), spruce grouse (*Falcipennis canadensis*; 1960s) and ruffed grouse (*Bonasa umbellus*; 1960s).

Although the marten is an opportunistic feeder and introduced species are consumed, the meadow vole remains the most frequent food item throughout the year (Gosse and Hearn 2005). The meadow vole is normally associated with open habitat, but occupies overmature or old-growth coniferous forests in Newfoundland (Sturtevant and Bissonette 1997). Snowshoe hares are the most important food item in winter. Other prey items such as masked shrew, red squirrel, birds and carrion are also consumed more frequently in winter. *Clethrionomys* spp. and *Microtus* spp. are the most frequent prey items for marten across North America (Stickland and Douglas 1987). Consumption of southern red-backed voles is expected to increase as the species expands its range (Gosse and Hearn 2005). The effect of competition between meadow voles and southern red-backed voles on their respective population levels and habitat use, affecting the biomass of prey available to marten, remains unknown (B. Hearn and J. Gosse, pers. comm., 2007).

POPULATION SIZES AND TRENDS

It is difficult to accurately estimate the population size of marten in Newfoundland, due to limited data from field studies and inadequate or outdated habitat suitability mapping. Population estimation is further compounded by small, widely dispersed and, possibly, isolated sub-populations, and variable habitat quality across the population

range. Snyder and Hancock (1985) estimated the population at 630 to 875 marten, based on densities derived from live-trapping studies, distribution determined from a trapper questionnaire, and locations of sightings and accidental mortalities. They delineated high and low density areas in western Newfoundland, and assumed no population in the Terra Nova area despite translocations in 1982-83 (Slough 1994). The total area of occupancy was assumed to be 13,354 km^2, of which 4,551 km^2 was a high density area.

Bissonette *et al* (1988) estimated 150 marten in the 790 km^2 Environmental Assessment Area based on areas of home ranges that contained suitable habitat of 7 resident marten (6.64 km^2 for females and 9.19 km^2 for males) and the area of available habitat (561 km^2 of mature softwood and mixed-wood).

I. Thompson (pers. comm., reported in Forsey *et al.* 1995) estimated the Newfoundland population to be 300 marten, based on densities estimated by Bissonette *et al.* (1988), a habitat supply analysis and known distribution (600 km^2 of prime marten habitat, including Terra Nova). This estimate was very close to the minimum viable population estimate of 237 (Thompson and Harestad 1994).

Marten reintroductions to Terra Nova National Park in the 1980s established a population of 25-30 individuals (Gosse *et al.* 2005). Home range estimates of 29.5 km^2 for males and 15.2 km^2 for females are considerably larger than elsewhere in North America, reflecting the low diversity and abundance of prey (Gosse *et al.* 2005) and naturally fragmented landscape (Hearn *et al.* 2005). Fuller *et al.* (2006) report home ranges from Newfoundland marten of 30.8 km^2 and 12.8 km^2 for males and females, respectively. Marten demography and habitat use were studied in southwest Newfoundland between 1995 and 2000 (Hearn *et al.* 2005). One hundred and sixty-eight individual marten, including 97 adults, were captured in a 2,278 km^2 area over a 5-year period, providing a minimum estimate of population status in that area.

I. Schmelzer (pers. comm., 2007) combined information on marten distribution, a range of area-specific densities and probability of occupancy in different habitat types to estimate a range of population sizes. Distribution was based on live-trapping studies, accidental captures, radio telemetry, bait stations, and verified incidental sightings collected between 1990 and 2006. A small number of locations distal from core and peripheral areas were excluded as cases of possible vagrancy. Marten locations were classified as either 'adult', 'juvenile' or 'unknown' (Figures 2 and 3). Core and peripheral areas of occurrence based on verified marten locations 1990-2006 were delineated, where core areas enclosed regions occupied by animals confirmed as adult resident animals and peripheral areas contained juveniles or animals of unknown age, likely transients. Densities were calculated for the three largest core areas (95% of the total core area) by dividing the effective trapping area (ETA) for each region into the number of unique animals captured plus the number of radio-collared animals relocated within the area. Two separate density values were calculated for each core area: the first, a 'high density' value was based on an estimate of population size within the ETA in 2006, and the second, a 'mean density' value was based on the average density over all years of trapping at each site. Mean densities ranged from 0.04 to 0.08 marten/km^2 and high

densities from 0.09 to 0.14. Densities in the peripheral areas were assumed to be 20% of those in the core areas, or 0.016 marten/km^2. It was assumed that densities in study areas were representative of those on the landscape, and that they could be extrapolated across each core area.

Habitat was modelled after Fuller *et al.* (2006) using the habitat classes identified as 'suitable' in Hearn *et al* (2005). This model is based on an analysis which suggests that the most important predictor of marten occurrence was the amount of suitable habitat within a potential home range. Four occupancy thresholds ranging from 60% to 89% were chosen on the basis of observed levels of suitable habitat in studied marten, model sensitivity and specificity, and to capture a large (85%) proportion of potential marten home ranges. This model assumed no gender-based differences in habitat use, and that a dichotomous ('used' versus 'not-used') description of habitat was adequate in determining the probability of occupancy.

Given the positive relationship between probability of occupancy and the amount of suitable habitat within a potential home range (Fuller *et al.* 2006), it would be unrealistic to assume a constant rate of occupancy for areas with varying amounts of suitable habitat types. Therefore, population size was estimated as the sum of areas (associated with each habitat occupancy threshold) X density for 'mean' and 'high' density values for each core area and the peripheral area, multiplied by the probability of occupancy. Probability of occupancy was determined using two methods.

One method was the model-predicted Probability of Occupancy (POA) associated with each occupancy threshold (Habitat area for each of 4 occupancy thresholds from Fuller *et al.* (2006) X Marten density (mean and high values, respectively) X Probability of occupancy for each of the 4 probability thresholds). The estimate from this method was 561 to 852 marten (Table 1, Probability of Occupancy).

The second method used the empirical relationship expressed in the cumulative occupancy rate of all home ranges versus the percent suitable habitat within the home range of all marten included in the study (Cumulative Decay Function) (Area X Density as above, but probability of occupancy determined by the proportion of marten retained as suitable habitat declines to the level associated with each of 4 occupancy thresholds. The estimate from this method was 438 to 661 marten (Table 1, Cumulative Decay Function).

Table 1. 2007 Newfoundland marten population estimates[1]

Method		Probability of Occupancy		Cumulative Decay Function	
Marten Density Estimate		**Mean**	**High**	**Mean**	**High**
Region	Area (km^2)				
Main River	2,177	117	190	94	153
Terra Nova	2,829	55	102	47	80
Little Grand Lake/Red Indian Lake	6,232	310	481	237	368
St. Georges	590	16	16	14	14
Peripheral	11,555	63	63	46	46
Total	23,483	561	852	438	661

[1]from I. Schmelzer (pers. comm., 2007). See text for description of methods.

The estimates, while not directly comparable to those made by Snyder and Hancock (1985) and I. Thompson (pers. comm., reported in Forsey *et al.* 1995), are based on better information and should be more accurate. Expected marten range is more broadly defined and more extensive than in both 1985 and 1995. This suggests that gains in distribution (equivalent to 10,000 km^2) have occurred in the Main River and Terra Nova areas. The sub-population of the Main River area in particular is larger and 75% of this core area contains habitat with a probability of occupancy exceeding 78%. Future surveys are planned in the peripheral areas to determine actual densities, and possible extensions to the known core areas across a range of land use activities (J. Brazil, pers. comm., 2007). The high density estimates are probably overestimates for non-protected areas where hare snaring and trapping still occur.

The population estimates include all age classes. Non-reproducing juveniles (12 months of age and younger) make up approximately 22% of the population. Assuming an equal sex ratio and pregnancy rate of 60% for females in their second year and 100% for older females, then the lower estimate of 438 marten would include about 150 breeding females, distributed among the 4 main core areas. The estimate of 'mature' marten (reproducing females and all males older than 12 months) would range from 320 to 622.

Earlier efforts to model Newfoundland marten extinction probability based on the old-growth paradigm are no longer valid (Thompson 1991, Schneider and Yodzis 1994, Schneider 1995, 1997). Additive mortality from hare snaring, however, continues to prevent marten from colonizing unoccupied habitats.

Fluctuations and trends

A long-term population decline probably began in the mid-19th to early 20th century (Bergerud 1969; Snyder 1985; J. Brazil, pers. comm., 2006, summary of historical accounts). Marten sub-populations have recently increased in the Terra Nova and Main River areas after translocations in the 1980s. Habitat protection and efforts to reduce accidental capture are helping to stabilize populations, and population growth is possible under this management regime.

Marten populations typically vary in response to fluctuations of microtine prey species; alternative prey dampens the fluctuations. Newfoundland marten were thought to be highly dependent on the meadow vole, which prefers old growth forests (Sturtevant and Bissonette 1997) and undergoes population fluctuations. Snowshoe hares occupy younger conifer stands and are an important alternate prey, especially in winter (Gosse and Hearn 2005). The large home ranges and the extreme variability of home range size among years (6.37 – 67.24 km^2 for males and 4.35 – 46.5 km^2 for females; Gosse *et al.* 2005) likely reflects the low diversity and abundance of prey species as well as the highly fragmented habitat (B. Hearn, pers. comm., 2006).

Rescue effect

There are no neighbouring populations of the subspecies *Martes americana atrata* which are likely to immigrate to Newfoundland. There is no possible rescue effect for this genetically and ecologically distinct Newfoundland population.

LIMITING FACTORS AND THREATS

The major limiting factors are accidental trapping and snaring and habitat loss due primarily to logging. Secondary limiting factors are habitat loss due to fire and insect damage and a limited prey base.

The Newfoundland marten's habitat requirements are not limited to mature and overmature coniferous forests (Hearn *et al.* 2005); therefore it is questionable whether habitat loss from forest harvesting remains the most serious limiting factor as suggested by Forsey *et al.* (1995).

An outbreak of encephalitis, likely caused by distemper, killed 10 of 40 study animals at Little Grand Lake in 1986-87 (Bissonette *et al.* 1989, Fredrickson 1990). No other diseases or significant parasite problems have since been reported (J. Brazil, pers. comm., 2007). Catastrophic mortality, in addition to other limiting factors and risks, can greatly increase extinction risk (Thompson 2004).

The prey base is limited compared to other parts of the marten's range in North America. Introductions of prey species, in particular snowshoe hares and, recently, southern red-backed voles (Hearn *et al.* 2005) may enhance the marten's viability in Newfoundland. On the other hand, concurrent increases in predator populations may threaten marten.

The incidental capture of marten in snares set for snowshoe hares and, to a lesser degree snares and traps set for red fox, is a significant source of mortality for Newfoundland marten (Forsey *et al.* 1995). Newfoundlanders snare and hunt about 1.8 million snowshoe hares per year (Forsey *et al.* 1995). Hare snares are non-selective and capture marten incidentally (Proulx *et al.* 1994). An annual average of 5 accidentally snared marten is reported, but researchers documented 10 to 17 marten mortalities when actively seeking snared marten from persons snaring hares from 1984 to 1987 (Forsey *et al.* 1995). This source of mortality is considered a serious impediment to marten dispersing from refuges to unprotected vacant habitats (Forsey *et al.* 1995, Thompson and Curran 1995). The degree of compliance of trappers in no- and modified snaring zones has not been assessed.

Proulx *et al.* (1994) proposed a snare system that killed snowshoe hares, but from which marten could escape. Using differences in torque and tension exerted by marten and hare, snare wires which hold hares but release marten have been tested (Fisher and Twitchell 2003, 2004). Modified snares and traps are mandatory in zones in

5,235 km^2 of Newfoundland; Corner Brook-Grand Lake, Red Indian Lake, Gros Morne and Terra Nova areas.

SPECIAL SIGNIFICANCE OF THE POPULATION

The American marten is one of only 14 mammals native to Newfoundland (Dodds 1983). The genetic and ecological uniqueness of the Newfoundland population makes it an important component of biodiversity in Canada.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

The American marten population of Newfoundland is protected under the federal *Species at Risk Act*. The population was designated Endangered in May, 2000 and is listed on Schedule 1. The general status of the population in Newfoundland was "At Risk" in 2005 (Canadian Endangered Species Conservation Council 2006) and the species was provincially designated Endangered in 2002 under the Newfoundland and Labrador *Endangered Species Act*.

The provincial *Endangered Species Act* protects the Newfoundland marten population from activities such as harassment, capture, trade, and killing. Commercial trapping has been illegal since 1934. There continues to be accidental capture in traps and snares set out for other species.

All trapping and snaring has been prohibited in the three protected areas established in 2002; the Little Grand Lake Provisional Ecological Reserve (731 km^2), the Little Grand Lake Wildlife Reserve (569 km^2) and the Glover Island Public Reserve (178 km^2). Trapping and snaring are also prohibited in the Main River Study Area (200 km^2), Terra Nova National Park and parts of Gros Morne National Park (Government of Newfoundland and Labrador 2006).

Modified hare snares, from which marten can be released, are required in 4 zones; the Northwest Grand Lake, Red Indian Lake, Terra Nova and Charlottetown Enclave areas (total of 5,236 km^2). The live-release of accidentally captured marten is encouraged in all areas. A total of 57% of the areas of occupancy is protected against accidental mortality (I. Schmelzer, pers. comm., 2007).

TECHNICAL SUMMARY

Martes americana atrata
American marten, Newfoundland population — Martre d'Amérique, population de Terre-Neuve
Range of Occurrence in Canada: Newfoundland

Extent and Area Information	
• *Extent of occurrence (EO)(km²)* Based on map data provided by the Wildlife Division, Newfoundland and Labrador Department of Environment and Conservation	68,700 km² (using COSEWIC guidelines), 23,483 km² (omitting unoccupied region between eastern and western populations).
• *Specify trend in EO*	Probably stable to increasing
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)* Based on map data provided by the Wildlife Division, Newfoundland and Labrador Department of Environment and Conservation	11,828 km² in 4 core areas with resident marten: Terra Nova, 2,829 km²; Main River, 2,177 km²; Little Grand Lake-Red Indian Lake, 6,232 km², St. George's, 590 km²). Additional peripheral areas of 11,555 km² contain juveniles, unconfirmed residents, and some residents.
• *Specify trend in AO*	Probably stable to increasing
• *Are there extreme fluctuations in AO?*	No
• *Number of known or inferred current locations*	4 core areas, and peripheral areas.
• *Specify trend in #*	Stable
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat*	Probably stable to increasing
Population Information	
• *Generation time*	2 - 3 years
• *Number of mature individuals*	320 to 622
• *Total population trend:*	Stable to increasing
• *% decline over the last/next 10 years or 3 generations.*	
• *Are there extreme fluctuations in number of mature individuals?*	No
• *Is the total population severely fragmented?*	Yes; 4 core areas lack sufficient connectivity
• *Specify trend in number of populations*	Probably stable
• *Are there extreme fluctuations in number of populations?*	No
• List populations with number of mature individuals in each: – Main River – 71-143 – Terra Nova – 35-77 – Little Grand Lake/Red Indian Lake – 178-361 – St. Georges – 11-12 – Peripheral – 35-47	
Threats (actual or imminent threats to populations or habitats)	
– Habitat Threats: Forestry, insect defoliation, forest fires, forest succession to mortality. – Population Threats: Non-target trapping and snaring mortality, limited prey base, population fragmentation.	

Rescue Effect (immigration from an outside source)	
• *Status of outside population(s)?* **North America:** Secure populations occur across most the boreal forests of North America, including the subspecies range in northern Quebec and Labrador.	
• *Is immigration known or possible?*	No
• *Would immigrants be adapted to survive in Newfoundland?*	Possibly not; the Newfoundland population exhibits morphological and ecological adaptations.
• *Is there sufficient habitat for immigrants in Newfoundland?*	Yes
• *Is rescue from outside populations likely?*	No
Quantitative Analysis	Not applicable
Current Status **COSEWIC:** Endangered, May 2000 Threatened, April 2007, **federal *Species at Risk Act*:** Newfoundland and Labrador Schedule 1- Endangered **provincial:** *Endangered Species at Risk Act*: Endangered	

Status and Reasons for Designation

Status: Threatened	**Alpha-numeric code**: D1
Reasons for Designation: Marten in Newfoundland have declined substantially over the last century. The current population consists of 300-600 mature marten in 5 subpopulations. It is still at risk because of snaring and trapping outside of protected areas and because of forest harvesting. A small decrease in population size would likely result in consideration for Endangered status. The marten is one of few land mammals native to Newfoundland and the sub-species is endemic to Canada.	
Applicability of Criteria **Criterion A**: (Declining Total Population): No evidence of decline over the past 10 years. If protected against hare snaring, the population may increase. In areas where forest harvesting is controlled. **Criterion B**: (Small Distribution, and Decline or Fluctuation): area of occupancy is greater than 2,000 km^2 and there is no evidence of continuing decline. **Criterion C**: (Small Total Population Size and Decline): There are only 300-600 adult marten, but there is no evidence of ongoing decline. **Criterion D**: (Very Small Population or Restricted Distribution): There are fewer than 1,000 mature marten, so it fits D1 – Threatened. There appear to be more than 250 mature marten, so D1 – Endangered does not apply. **Criterion E**: (Quantitative Analysis): not available.	

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BIOGRAPHICAL SUMMARY OF REPORT WRITER

Brian Slough obtained an M.Sc. from Simon Fraser University. His thesis on land capability classification for beaver, *Castor canadensis*, led him to a 15-year career as furbearer management biologist with the Yukon Fish and Wildlife Branch. The marten is an important economic furbearer for Yukon trappers, and as such, considerable effort was spent monitoring and studying marten.

Marten harvests were carefully monitored with a state-of-the-art fur harvest monitoring system. Marten populations were monitored using winter track-count and trapper questionnaire indices. The Yukon Trapper Questionnaire is a vehicle for obtaining local knowledge from First Nation and non-First Nation trappers on furbearer population levels and trends. Mr. Slough led a marten translocation project, to augment isolated populations and fill vacant habitats in the southwest Yukon.

The information collected on marten was applied to marten management guidelines, land use guidelines for marten and marten trapline management recommendations which are presented in a brochure for trappers and are presented at annual Yukon trapper education workshops.

He has published work on furbearer species including beaver, arctic fox, *Alopex lagopus*, American marten, *Martes americana*, and Canada lynx, *Lynx canadensis*, and has also written about trapline management and furbearer management in northern and western Canada. Since leaving the Yukon government in 1996, Mr. Slough has conducted environmental assessments, protected areas research, and research on rare mammals and amphibians. He prepared the 2003 update COSEWIC status report on wolverine, *Gulo gulo*.